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ABSTRACT

Frequency data are reported from a research project aimed at developing the Behavior Observation Scale (BOS), an objective assessment tool for establishing the diagnosis of autism. The goals of the BOS are to differentiate autistic, normal, and mentally retarded children (ages 30 to 60 months) along objective symptom axes involving 67 behaviors. Operational definitions and procedures are described, and frequency analyses of the preliminary data based on 140 children are reported. These data indicated that in order to determine the diagnostic importance of any behavior, both the frequency of occurrence and percentage of children exhibiting the behavior must be considered simultaneously. The results are discussed in terms of methodological problems encountered in attempting to establish objective diagnostic criteria for the syndrome of autism. (Author/DLS)

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The Behavior Observation Scale for Autism (BOS): Frequency Analyses[1]

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The Behavior Observation Scale for Autism (BOS):

Frequency Analyses

Abstract

Frequency data from a research project aimed at developing an objective assessment tool for establishing the diagnosis of autism are reported. The goals of the Behavior Observation Scale (BOS) are to differentiate autistic, normal and mentally retarded children (ages 30-60) months along objective symptom axes. Operational definitions and procedures are described and frequency analyses of the preliminary data based on 140 children reported. These data indicated that in order to determine the diagnostic importance of any behavior both the frequency of occurrence and percentage of children exhibiting the behavior must be considered simultaneously. The results are discussed in terms of methodological problems encountered in attempting to established objective diagnostic criteria for the syndrome of autism.

The Behavior Observation Scale for Autism (BOS):

Frequency Analyses

In spite of the vast literature that has appeared in the last thirty years on the subject of autism, there is as yet no objective method for quantifying behaviors considered to be autistic. Clinical descriptions of the syndrome are rich but provide no objective definitions of the behaviors they describe. Attempts to quantify the diagnosis by the use of checklists and rating scales have not received widespread use because they fail to define behaviors objectively, generally rely on parental report, do not observe the children directly and have a priori definitions of autism which they attempt to confirm. Reports of observations of behaviors in structured settings have been aimed at quantifying autistic behaviors but fail to describe the syndrome as a whole.

Several methodological problems have limited the development of objective diagnostic systems. First, the majority of studies do not utilize appropriate comparison groups and do not acknowledge the overlap among behaviors exhibited by children with the syndromes of autism, mental retardation as well as normal children (cf., Freeman, Ritvo, Guthrie, Schroth and Ball, 1979; Freeman, Guthrie, Ritvo, Schroth, Glass and Frankel, 1979). Secondly, the syndrome of autism represents a heterogeneous set of symptoms. Therefore, in order for a scale to be comprehensive, it is necessary to directly observe large groups of children and record many behaviors simultaneously.

This heterogeneity of symptoms can manifest itself in several ways which further complicates the development of a direct observational behavioral code. For example, various subgroups of autistic children may show different sets of behaviors. Bartak and Rutter (1976) found that autistic children with testable IQ's above 70 showed a different patterning of symptoms than those with testable IQ's above 70. Thus, an objective diagnostic scale must encompass a wide variety of behaviors only some of which any given child would be expected to exhibit. The result is that some of the behaviors recorded, while of diagnostic importance, may occur very infrequently.

Another problem occurs when only one behavior occurs for an entire observational period. This can inflate the overall mean frequency of occurrance for the group. As a result, a behavior shown primarily by one child can lead to a misinterpretation of its importance in the data analysis. Finally, there will be behaviors which many of the children exhibit at least once but usually not more often. This results in a low overall mean frequency of occurrance and can also lead to a misinterpretation of the behavior's importance. Thus, in order to mitigate these problems and determine which behaviors are of diagnostic importance, it is necessary to examine both the frequency of a specific behavior and the number of children in a group who actually exhibit the behavior. Few studies to date have attempted to document how many children diagnosed as autistic actually exhibit the behaviors which compromise the clinical syndrome.

The purpose of the present study was to examine the frequency of occurrance of 67 objectively defined behaviors in groups of autistic, mentally retarded and normal children. The data were collected as part

of a large research project, The Behavior Observation Scale of Autism. The primary objectives of the research project to be described are: 1) to develop an objective Behavior Observation Scale (BOS) which will differentiate autistic from normal and mentally retarded children (30-60 months of age); 2) to differentiate subgroups of autistic children along various symptom axes; 3) to establish a quantitative continuum of severity within each symptom subgroup ; 4) to provide an objective means of describing children who serve as subjects in biological research; 5) to periodically reevaluate autistic children and thus trace the natural history of the syndrome. However, before these goals can be met, it is first necessary to determine the frequency of occurence of behaviors which make up the syndrome of autism as well as the number of autistic children who exhibit the behaviors. Furthermore, in order to determine the diagnostic importance of a specific behavior, it is necessary to compare the behavior of autistic to mentally retarded and normal children.

METHODS

Subjects

Subjects for this research report included: 1) 59 children who meet the National Society for Autistic Children's (1978) diagnostic criteria for the syndrome of autism; 2) 35 children with a diagnosis of mental retardation matched to the autistic group on the basis of mental age obtained on the Merrill-Palmer Preschool Performance Test (Stutsman, 1931); and 3) 30 normal children matched to the other two groups on chronological age.

Each child in the project was examined by two Board Certified child psychiatrists who determined the child's diagnosis. If there was disagreement between the psychiatrists (2 cases only), these data were not included in the analyses. Developmental histories were taken, language and cognitive tests and medical examinations were given.

Table I shows the frequency distribution of chronological ages and Table II shows the distribution of mental ages and IQ obtained on the Merrill-Palmer Performance Test for the three groups. Table 2

Insert Table I & II About Here

shows that the autistic and mentally retarded groups were matched very closely on all paramenters while the normal group was matched to the autistic and mentally retarded groups on chronological age, but not on mental age and IQ.

Procedure

The Behavior Observation Scale (BOS) contains 67 objectively defined behaviors which are listed in Table III Each child was observed

Insert Table III about Here

through a one-way mirror in a playroom setting. The playroom contained age appropriate toys, a child's table and chair, two toy boxes, and one adult chair.

Each child was brought into the room by the examiner who told the child "to do anything he/she wants". If the child was crying, observations did not begin until the child was quiet. Once the child quieted, the examiner was seated in the corner and the observations begun.

Each observation consisted of recording the occurrence of the 67

behaviors defined on the BOS in nine, three-minute intervals. Each behavior was scored as follows: A score of "0" meant that the behavior did not occur in the three-minute interval, a score of "1" meant the behavior occurred once, a score of "2" meant it occurred twice and a score of "3" meant the child engaged in the behavior more or less continuously throughout the entire three minute period. In addition, responses to standardized stimuli (e.g., spinning top, burglar alarm, intermittent flashing light, flashlight, a texture ball, tuning fork, and the examiner) were recorded during the first ten seconds of seven of the nine intervals. Each session began and ended with a three-minute baseline observation period. During the procedure the examiner in the playroom presented the various stimuli without comment. During one of the three minute intervals the examiner actively interacted with the child by attempting to engage in ball play. At all other times, the examiner was passive, sat in a corner and did not respond if the child initiated contact.

Initial data were obtained by observing each child on three occasions, approximately one week apart. All behaviors were counted by two observers (the examiner in the room and another viewing via a one-way mirror) and exact agreement (i.e., number of agreements/number of agreements plus disagreements) interobserver reliability obtained. The procedure seems practical and high interobserver reliability ($r = .80$ on all but seven behaviors indicated by an asterik in Table III has been obtained.

Data Analysis

Composite scores for each behavior were computed from the recorded ratings across observers, observation intervals, and sessions. Thus, each of the 140 children received scores which were the average of 54

observations for each of the 67 behaviors. Complete data were available on 121 children, 53 autistic, 35 mentally retarded and 33 normal. Several behaviors having to do with specific use of the toys and crying were not recorded during the initial phases of the study and were thus eliminated. For statistical analysis, delayed and negative echolalia occurred so infrequently that they were combined with immediate echolalia and considered as one variable, echolalia. In addition, the measurement of communicative speech was rescaled by dividing by chronological age. This modification was employed because the use of speech is highly dependent on maturation. Thus, 59 variables were included in the subsequent analyses.

In this paper the results of frequency analyses will be described. Two types of frequency analyses were conducted. First, simple occurrence versus nonoccurrence of the behaviors were examined and the percentage of children in each group that exhibited the behaviors at least once was computed. Second analyses of variance were used to compare the groups between and within sessions as well as overall mean rates of occurrence of each behavior.

Results

No significance between or within session differences in the occurrences of the behaviors or responses to stimuli among the groups were found. However, analysis of variance on the mean rate of occurrence across sessions revealed that the groups differed significantly on 26 behaviors. The behaviors are divided into descriptive groups and the means of each of these behaviors for each group and the F-value are shown in Table IV. A close examination of Table IV indicates that with the exceptions of Toe-Walking and Finger-Wiggling in the normal group,

INSERT TABLE IV

all of the behaviors occurred in all of the groups. However, the mean frequency of many of these behaviors was extremely low.

In order to further examine these low frequency behaviors the percentage of children in each group who exhibited a behavior at least once across the three sessions was computed. These results are shown in Table V.

INSERT TABLE V

A careful examination of Table V indicates that some behaviors which have a low frequency occur in a large percentage of the children. For example, Finger-Flicking had a mean rate of occurrence of .060 in the autistic group and .040 in the retarded group. However, 52.5% of the autistic and 30% of the retarded children exhibited the behavior at least once.

On the other hand, the behavior Whirling had the same value of .060 in the autistic group as did Finger-Flicking but only 18.6% of the children exhibited the behavior. Thus, although fewer children engaged in this behavior, they did so more frequently.

There were also behaviors which occured in a high percentage of children in all groups but which occurred with different frequencies, e.g., Repeats Sounds, Visual Detail Scrutiny, Eye Contact, Ignores Examiner. Thus, the amount of these behaviors exhibited became important in differentiating among the three groups.

These results indicate that in order to differentiate among the groups both the frequency and percentage measures must be considered. When this

is done, behaviors listed in Tables IV & V can be divided into the two following groups: 1) Those which differentiate the normal from the autistic and retarded groups but do not differentiate the two diagnostic groups from each other; and 2) Those which differentiate the autistic from the other two groups. Table VI lists these two groups of behaviors. A close examination of these groups indicate that those which fail to differentiate the autistic and retarded groups are more dependent on mental and/or chronological age than those that differentiate among the diagnostic groups. Therefore, these two groups of behaviors may be of differential diagnostic importance.

Discussion

This study represents one of the first attempts to systematically document the actual frequency of occurrence of behaviors clinically associated with the syndrome of autism and compare the incidence figures to those obtained in groups of mentally retarded and named children. Previous studies have typically either utilized global measures (cf., Ruttenberg, Kalish, Wener and Wolf, 1974) and/or parental report of the presence of the behaviors (cf., Prioi, Boulton, Gajzago and Perry, 1975). When specific behaviors are examined, data are usually reported on small samples and on only a few of the heterogeneous sets of symptoms which make up the syndrome. Furthermore, since the definition of the behavior as well as the method of observations differ, comparison of the results of the present study with these is difficult. However, a few scattered examples in the literature indicate that similar results have been obtained. For example, Bartak and Rutter (1976) reported a total of 58% of the autistic children in their sample showed repetitive hand movements. The present study found similar result. It would be of interest to examine the raw data obtained by other investigators and thus compare incidence figures across studies and procedures.

This study also demonstrates that there is overlap between behaviors exhibited by autistic children and those shown by both normal and mentally retarded children. These results are consistent with our earlier findings (Freemen, Ritvo, Guthirie, Schroth and Ball 1979) that many of the behaviors associated with autism vary developmentally. In addition, Freeman, Guthrie, Ritvo, Schroth, Glass and Frankel (1979)

reported that of the 67 items on the BOS, the autistic and mentally retarded groups differed from each other on only 11 items. While the earlier study was based on only 65 children, the same behaviors were found to separate the groups in the present study. Thus, before developing an objective diagnostic scale we must determine which of the many behaviors exhibited by autistic children are unique to the syndrome and which result from maturation and/or developmental delay.

The problem of determining which behaviors are of diagnostic importance for the syndrome of autism is further complicated by the finding in the present study that frequency of occurrence alone is not an adequate measure. The present results clearly indicate that a measure of the percentage of children who exhibit a behavior must be combined with the frequency measure before the diagnostic importance of a behavior can be determined. This problem is further complicated by the fact that the nonoccurrence of a behavior could be as diagnostically important as the occurrence of a behavior. For example, autistic children are often said to lack Eye Contact. Thus the failure to exhibit this behavior becomes important.

Whenever one begins to examine low frequency behaviors, the question of interrater reliability arises. Typically, low frequency behaviors are reported to have lower reliability (Hartmann, 1977). However, in the present study some of the lowest frequency behaviors had the highest reliability. This probably results from the fact that these behaviors, e.g., Whirling, Hand-Flapping, are very discrete behaviors which are easily defined and coded. On the other hand, some of the higher frequency behaviors such as Ignores Examiner and Toys Used Functionally are too general and difficult to code. Future revisions of the BOS will have to address these issues directly. One possible

solution would involve more molecular definitions of the behavior. That is, behaviors such as Toys Used Functionally will be divided into its components and each incidence recorded utilizing continuous recording techniques.

In summary, the results of this study indicate that it is practical to record objectively the behaviors associated with the syndrome of autism. However, frequency of occurrence alone is not an adequate measure. It must be considered in conjunction with the percentage of children who exhibit the behavior. Both of these measures must be taken together before the diagnostic importance of any particular behavior can be determined. Finally, these measures need to be applied developmentally to groups of autistic, mentally retarded and normal children in order to determine which of the many behaviors exhibited by autistic children are unique to the syndrome of autism and which result from maturation or overall developmental delay.

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Footnotes

[1]Supported by MH29248 awarded to senior author and, Maternal and Child Health Project #927, and MH30897 awarded to Peter Tanguay, M.D. for Clinical Research Center for the Study of Childhood Psychosis. Computing was done at the Health Sciences, Computing Facility, UCLA.

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TABLE 1

Chronological Age Distribution of Subjects

	Autistic	MR	Normal	Total
≥ 23	0	0	0	0
24-29	1	1	2	4
30-35	3	3	7	13
36-41	14	5	4	23
42-47	8	6	11	25
48-53	11	7	6	24
54-59	4	6	2	12
60-65	4	1	4	9
< 65	14	11	5	30
Total	59	40	41*	140

* MA & IQ not available on 1 subject.

Table VI

A. Behaviors which differentiate the Normal group from the Autistic and Retarded Groups

Mouths Objects
Sniffs Objects
Eye Contact
Social Smile
Leads Adult by Hands
Ignores Examiner
Babbles
Communicative Speech
Deviant Ball Play

B. Behavior which differentiate between the Autistic and Retarded groups

Repeats Sounds
Covers Ears
Looks at Hands
Visual Detail Scrutiny
Rubs Surfaces
Spins top- Inappropriately
Hand-Flapping
Finger-Flicking
Grimaces/Gesticulation
Whirling
Toe Walking
Posturing
Repetitive Jumping
Finger Wiggling
Toys used Functionally
Ritualistic Object Use

Score Obtained in Merrill-Palmer Pre-School Performance Test

	Autistic	MR	Normal	Total
≥ 23	16	12	0	28
24-29	11	9	1	21
30-35	12	5	1	18
36-41	4	3	3	10
42-47	3	4	4	11
48-53	4	1	5	10
54-59	5	3	5	13
60-65	0	2	1	3
< 65	4	1	20	25
TOTAL	59	40	40	139

B. Distribution
of IQ Scores Obtained on Merrill-Palmer Preschool Performance Test

	Autistic	MR	Normal	Total
≥ 30	8	5	0	13
31-40	3	5	0	8
41-50	6	4	0	10
51-60	13	4	0	17
61-70	8	11	0	19
71-80	7	9	0	16
81-90	6	1	0	7
91-100	2	1	3	6
101-110	3	0	5	8
111-120	2	0	6	8
121-130	1	0	8	9
131-140	0	0	6	6
141-150	0	0	5	5
151-160	0	0	5	5
< 160	0	0	2	2
TOTAL	59	40	40	139

General Behaviors (Each item scored 0-3):

Repeats Sounds (Attends to self-induced sounds)
Ear Banging
Tooth Grinding
Regards Hands (Looks at Hands)
Staring
Visual Detail Scrutiny
Rubbing Surfaces
Mouth Objects
Repetitive Banging
Mouths Hands
Sniffs Objects
Sniffs Hands
Spins Top
Hand-flapping
Finger-flicking
Gesticulation/Grimacing
Whirling
Toe Walking
Darting/Lunging
Posturing
Body Rocking
Repetitive Jumping
Head Banging
Finger Wiggling
Nuccal Hyperextension

Insists on Being Held
*Eye Contact
Attends to One Part of Adult
Social Smile
Uses Others as Extension of Self
Infantile Clinging
*Ignores Examiner
*Toys Used Functionally
Inspection of Objects
*Manipulation of Objects
Purposeful Toy Play
*Constructive Toy Play
Inappropriate Contact Attempt
*Remains Preoccupied
Orders and Arranges Objects
*Ritualistic Use of Objects
Uses Object to Generate Stimuli
Ignores Objects
Undifferentiated Holding of Objects
Lets Object Passively Fall from Hand
Spins Object
Uses Part of Body to Generate Stimuli
Turns Flashlight On/Off
Turns Gong On/Off

Language (Each item scored 0 or 1):

Mute
Babbles
Cries
Communicative Speech

Immediate Echolalia
Delayed Echolalia
Negative Echolalia

Response to Stimuli (Each item scored 0 or 1):

Delayed
Staring at Stimulus
Anticipatory Response to Gesture
Response to Command for Eye Contact

Attending Response (One item, scored 0-6):

None
Minimal
Mild
Moderate
Severe
Very Severe
Panic

Response to Being Held (One item, scored 0-2):

Resists
Tolerates
Accepts

Response to Ball Play (One item, scored 0-3):

Ignores
Minimal
Active
Deviant

Inappropriate Response to Pain (scored 0-1)

Motility Disturbance to Stimuli: (scored 0-1)

Table IV Behaviors Which Differed Significantly Among the Three Groups Means for Each Group

	AUTISTIC	RETARDED	NORMAL	F-Value
I. Solitary Behaviors				
A. Inspection of Body				
1. Covers Ears	.067	.025	.015	3.21*
2. Looks at Hands	.145	.056	.002	3.21*
3. Posturing	.329	.242	.062	10.98
B. Repetitive Solitary Behaviors				
1. Repetitive Jumping	.062	.012	.006	5.01
2. Repeats Sounds	.810	.470	.200	19.10
3. Grimaces/Gesticulations	.718	.443	.015	22.49
4. Whirling	.060	.006	.005	5.16
5. Hand-Flapping	.150	.039	.001	9.83
6. Finger-Eiggling	.137	.050		2.94*
7. Toe Walking	.040	.003		4.99

	AUTISTIC	RETARDED	NORMAL	F-Value
II. Relation to Objects				
A. Sensori-Motor Play				
1. Cover Ears	.067	.025	.015	3.21*
2. Visual Detail Scrutiny	.420	.234	.100	14.30
3. Rubs Surfaces	.480	.340	.220	5.36
4. Mouths Objects	.380	.380	.080	7.58
5. Sniffs Objects	.035	.023	.002	3.94
6. Finger-Flicking	.060	.030	.010	4.52
B. Manipulation of Objects				
1. Purposeful	.545	.730	1.650	46.70
2. Stereotypical/ Ritualistic Use of Objects	.761	.611	.274	23.98
a. Spins Top Inappropriately	.060	.040	.010	5.60
b. Deviant Ball Play	.026	.011	.001	14.32

	AUTISTIC	RETARDED	NORMAL	F-Value
III. Relation to Examiner				
A. Physical Contact Attempts Leads Adult by Hand	.031	.019	.001	6.31
B. Non-Physical Contact Attempts				
1. Ignores Examiner	1.650	1.240	.870	16.07
2. Eye Contact	1.074	1.380	1.56	14.88
3. Social Smile	.210	.440	.750	17.50
4. Communicative Speech	.1.9	.265	.598	27.62
IV. Language				
A. Non-Communicative				
1. Babbles	.570	.496	.252	14.74
2. Echolalia	.030	.010	.0001	8.86

*p = .05, otherwise P .001

Table V Behaviors Which Differed Significantly Among the three groups. Percentage of Children in Each Group Exhibited Each Behavior

	AUTISTIC	RETARDED	NORMAL
I. Solitary Behaviors			
A. Inspection of Body			
1. Covers Ears	45.7%	30.0%	31.70%
2. Looks at Hands	38.9%	20.0%	4.88%
3. Posturing	88.1%	75.0%	46.3%
B. Repetitive Solitary Behavior			
1. Repetitve Jumping	32.2%	7.5%	12.2%
2. Repeats Sounds	91.5%	87.5%	73.17%
3. Grimaces/Gesticulations	98.3%	87.5%	60.9%
4. Whirling	38.9%	15.0%	12.2%
5. Hand-Flapping	57.6%	32.5%	2.4%
6. Finger-Wiggling	44.0%	10.0%	0
7. Toe Walking	18.6%	5.0%	0

	AUTISTIC	RETARDED	NORMAL
II. Relation to Objects			
A. Sensori-Motor Play			
1. Covers Ear	45.7%	30.0%	31.70%
2. Visual Detail Scrutiny	94.9%	85.0%	63.40%
3. Rubs Surfaces	93.1%	97.5%	90.2%
4. Mouths Objects	84.7%	90.0%	60.0%
5. Sniffs Objects	37.3%	27.5%	7.32%
6. Finger-Flicking	52.5%	30.0%	19.5%
B. Manipulation of Objects			
1. Purposeful			
2. Stereotypical/Ritualistic Use of Objects	100%	97.5%	92.7%
a. Spins Top Inappropriately	60.9%	59.2%	25.0%
b. Deviant Ball Play	52.5%	30.0%	4.88%

	AUTISTIC	RETARDED	NORMAL
II. Relation To Examiner			
A. Physical Contact Attempts Leads Adult by Hand	40.7%	32.5%	4.88%
B. Non-Physical Contact Attempts			
1. Ignores Examiner	100%	100%	97.5%
2. Eye Contact	100%	100%	100%
3. Social Smile	71.2%	82.5%	96.7%
4. Communicative Speech	57.6%	65.0%	100%
V. Language			
A. Non-Communicative			
1. Babbles	94.9%	97.5%	90.2%
2. Echolalia	40.7%	15.0%	2.4%